

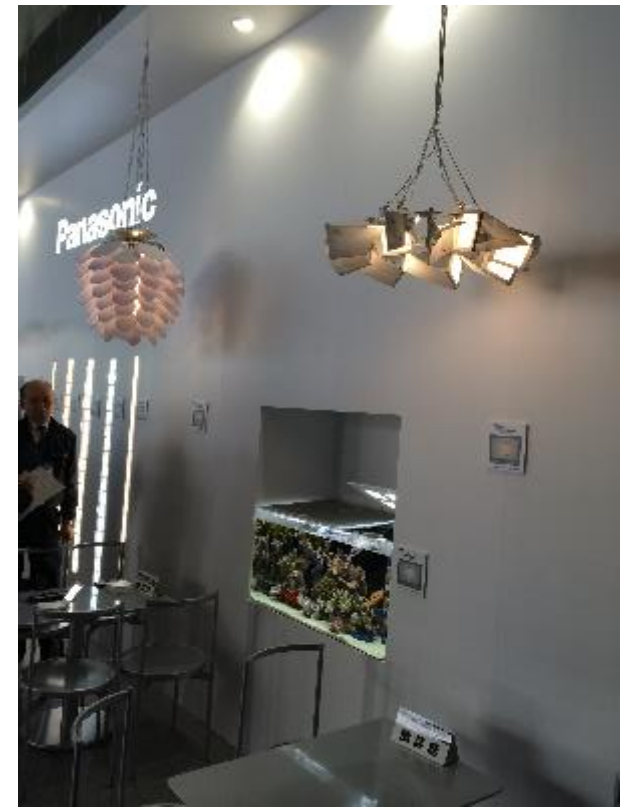
Status Check and Call for Further Progress

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LIGHTING JAPAN, Jan 14-16, 2014

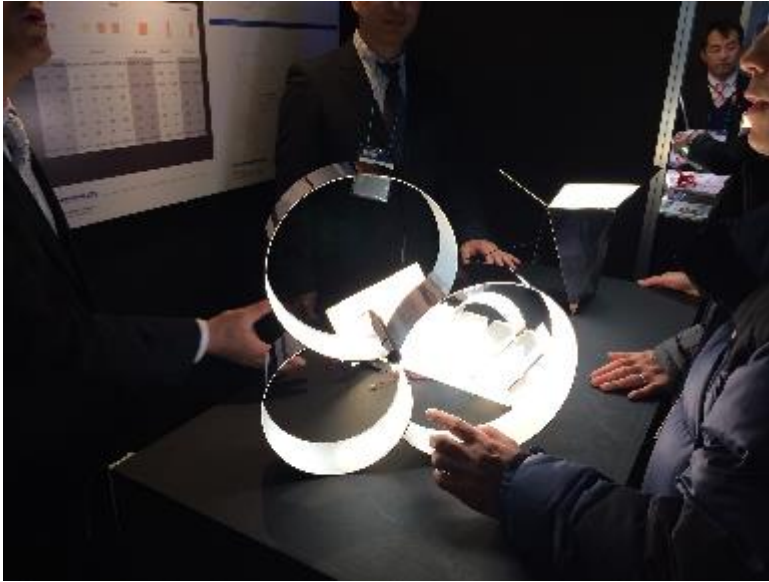


PIOL booth, square and rectangular panels, 3 CCTs



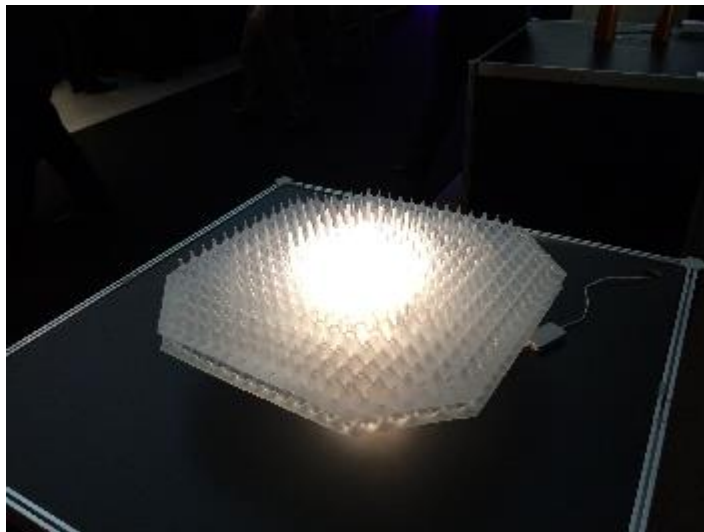
Synqroa fixtures using PIOL panels

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- LG Chem's new panels shown at a small booth of their Japanese agent
- Flexible 2" x 8" panels, 3000 and 4000K
- Large area panels, ~ 6" square and ~110 x 330 mm²

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Lumiotec

The most critical need for OLED lighting commercialization today:

- Luminaire Market Development
- OLED panel reliability and performance have reached a point where standard commercial products can be marketed.

MORE LUMINAIRE MANUFACTURER PARTICIPATION NEEDED

In a bicycle race



It's good to be part of the leader's pack.

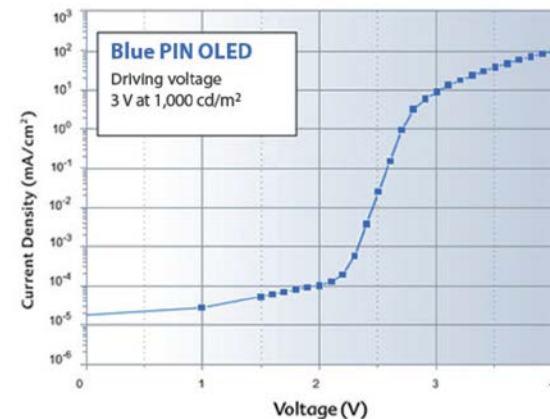
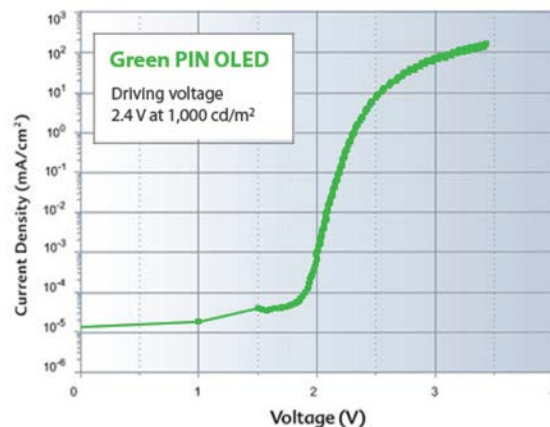
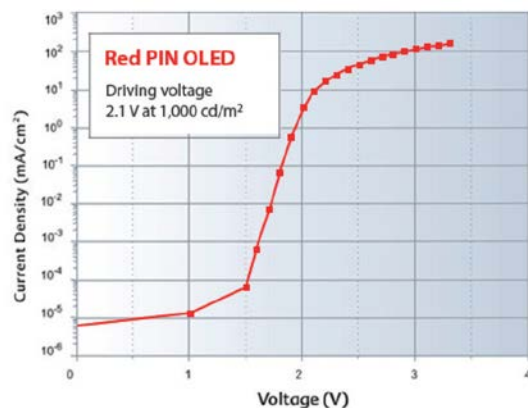


... but problematic if you're the lone rider in front.

- We need more luminaire manufacturers entering this market.

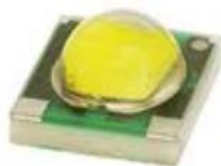
- Charge distribution and transport
 - Reduce drive voltage
- Light creation and extraction
 - High color quality OLEDs
 - Eliminating cathode quenching
- Encapsulation
 - Cost reduction

LOW TURN-ON VOLTAGES IN OLEDs



Source: Novaled

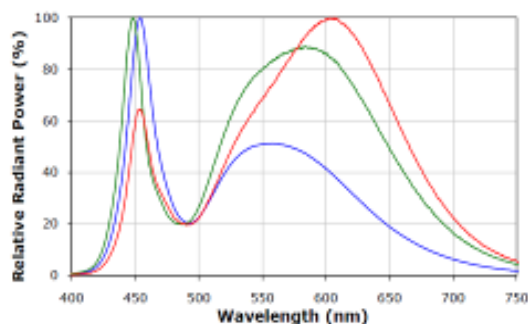
- Emission at forward voltage < photon energy/e
- Re-thinking the need for blue phosphorescence (3 stack structure, Tyan)
- Advantage over LEDs?



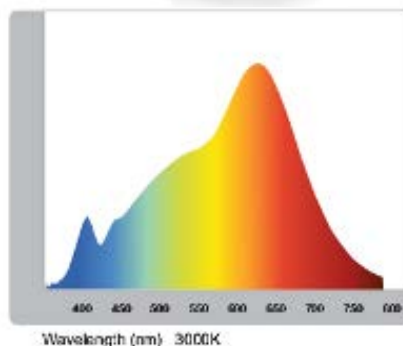
Xicato



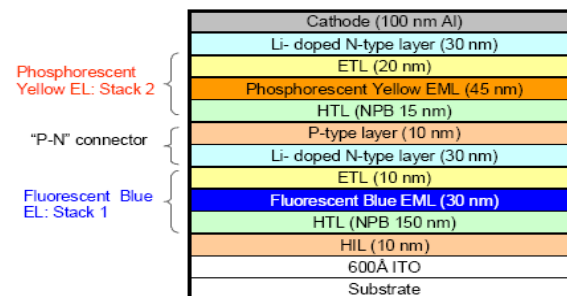
Soraa



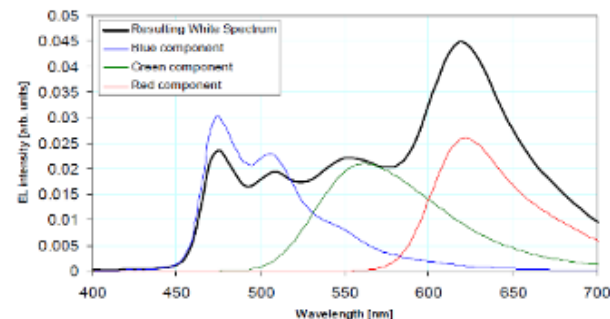
Typical pc-LED spectra
Today: 130-140 lm/W
CRI: Ra 70-85, R9 >0



Typical best-in-class LED
spectrum, 47-64 lm/W
CRI: Ra, R9 95+

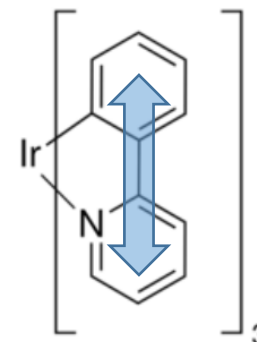
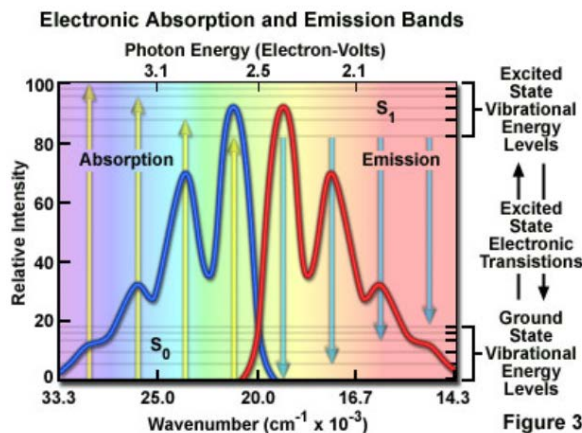
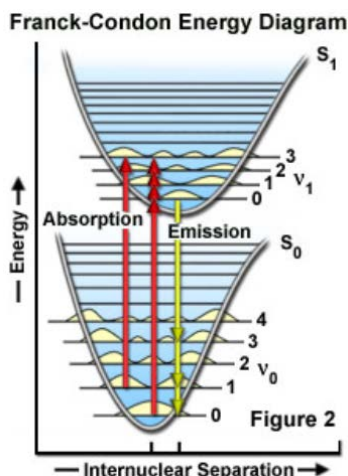


Tandem white OLED, Kodak, 2009,
up to **15** layers

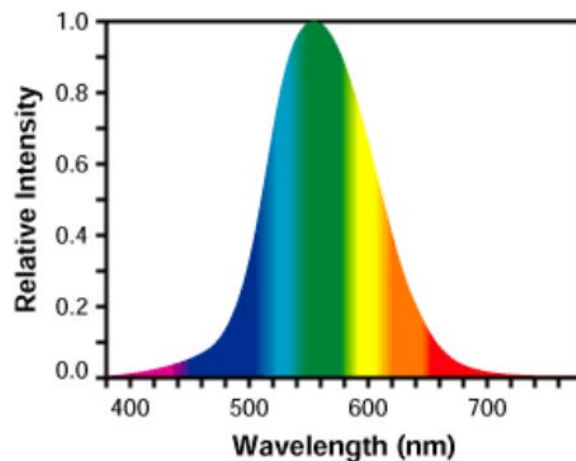


Typical OLED spectra
Today: 3000K, 56-59 lm/W
CRI: Ra 89-90, R9 30

- Target for high CRI: Ra > 90, R9 > 50
- Current LED modules can achieve very high Ra and R9
- OLEDs suffer less efficacy loss since starting from broad intrinsic spectra



- Vibronic levels give rise to broad right shoulder in phosphorescent dopant spectra.

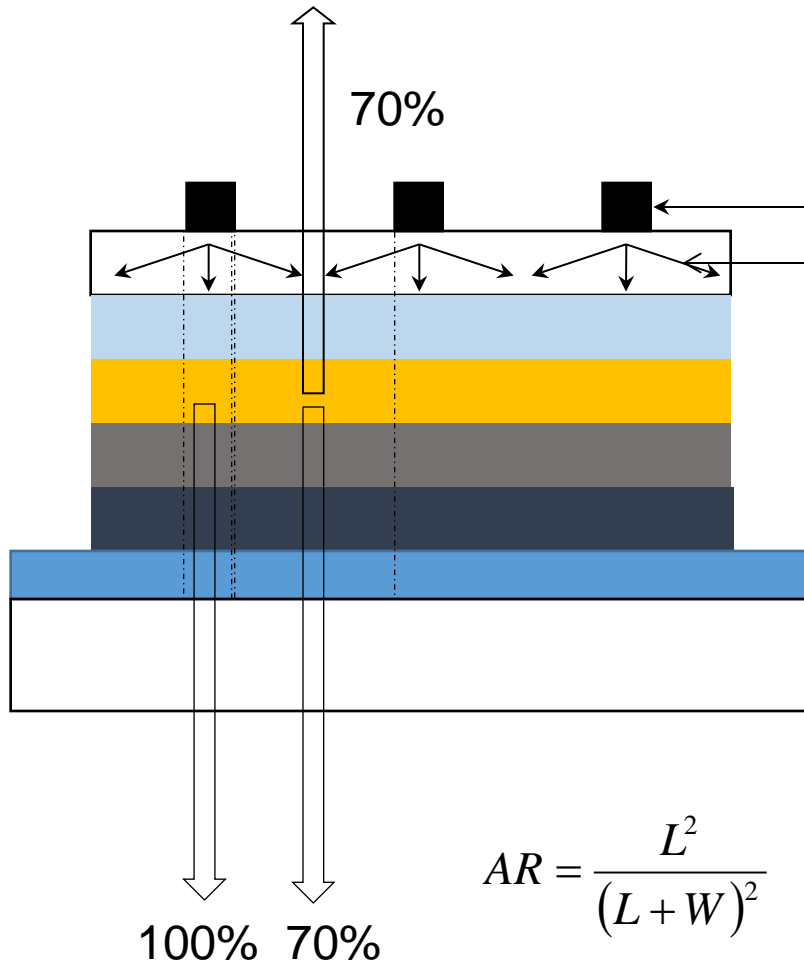


- Photopic curve $V(\lambda)$ falls off quickly in red.

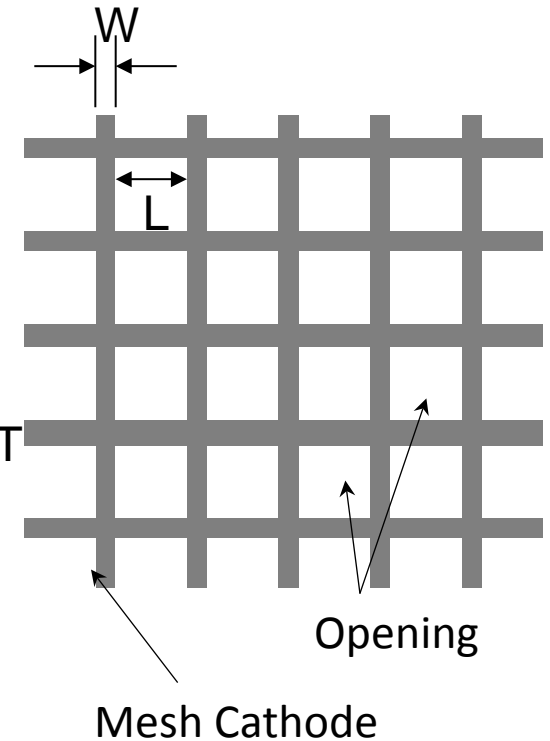
- High R9 and efficacy requires a red dopant with peak wavelength between 610-620 nm and narrow width.

ELIMINATE CATHODE QUENCHING WITH MESH CATHODE

Light from 100% of the area



$$AR = \frac{L^2}{(L + W)^2}$$



$W = 50 \mu\text{m}$, $L = 100 \mu\text{m}$, $AR = 44\%$.

$$\Delta\eta_{out} / \eta_{out} = AR \cdot \delta$$

δ : extraction efficiency gain in the open areas

$AR = 44\%$, $\delta = 40\%$:

$$\Delta\eta_{out} / \eta_{out} = 18\%$$

LEVERAGE NEW ENCAPSULATION METHODES FOR OLED TV AND FOLED

